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A Fresh Look at Cognition and the Individual

The series of papers prefaced by this article present* a new and in many ways controversial view of psychology and, perhaps, of cognition-science in general (for example, "artificial" intelligence, man–machine symbiosis, social regulation). The results reported are really the outcome of work by two groups; one, in the Biological Computer Laboratory (BCL) in Illinois (Von Foerster and his colleagues), and one at my own laboratory, System Research (SR) in Great Britain. As it happens, the authors of this series belong to the latter institution (SR) and we are wholly responsible for any errors of presentation. Moreover, the research has been carried out independently, with only irregular personal liaison. But it arose from the same basic ideas, it was jointly encouraged by McCulloch and it is heartening to find that the (near independent) conclusions reached differ only in the notation used and the favoured areas of application or experiment.

There are colleagues, too numerous to mention, without whom the endeavour would be idiosyncratic if not vaccuous. We have our patrons to thank—notably the SSRC and the USAF through its European Office. In particular, one figure stands out as appreciating the field from the outset and insisting on the communication of results—namely, Professor Rowena Swanson, previously a contract coordinator for AFOSR, and currently at Denver University.

1. My last paper in this journal (Pask, 1971) is of chiefly historical interest (it was penned in 1965–6). The need for a *conversational* paradigm became evident and the need was satisfied by an approximation; the requirement for a process model was obtrusive and met by not-quite-a-theory. Finally, it was clear that the near-linear structuring (modelling) of skills/tasks/subject-matters, however well it might serve for local applications, was quite inadequate for dealing with sizeable and interestingly complex bodies of knowledge.

The main defects lay not so much in what could be done as in the reasons for why it was done. Hence, the theoretical framework was drastically altered (some germs of the new ideas are obvious in the paper cited) and the main transition occurred at about the moment that paper was written. The interested reader may consult other publications that bridge the gap between the old and the new, thus establishing some continuity. An appreciable body of experimental work and practical application was needed to tie the concepts to actuality. This is reported for perceptual motor skills in Pask & Lewis (1967, 1968), Pask (1969) and Pask & Scott (1971), and in extracts from Bateson (1972). Two useful survey papers are Pask (1970*a*, *b*).

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*(1) "Learning Strategies and Individual Competence"; (2) "CASTE: A system for exhibiting learning strategies and regulating uncertainty"; (3) "A theory of conversations and individuals (exemplified by the learning process on CASTE)"; (4) "The representation of knowables"; (5) "Physical and psychological universes"; (6) "A theory of vehicles (M-Individuals)"; (7) "Applications of the theory of individuals in opinion sampling".

The new theory has five compartments.

1.1. The (sub) theory of *conversations* between two or more individuals. A conversation takes place within a contractual framework; and *this* rather than a stimulus/response system, is argued to be the *least* meaningful experimental situation. In a conversation (and conversations are many faceted, enough to adumbrate most types or experiment) it is possible to observe *psychological* events; in other situations, it is *not*. Observation consists in recording and interpreting dialogue between the participant individuals. Experimental regulation, parameter change, etc., is achieved by instructing one *participant* to execute a prescribed heuristic. It is crucial, however, that a participant does so, and not the observer, and that he retains the partiality as well as the liberty of a participant; hence, the heuristic is not to be equated with an algorithm. Often, it is convenient to study man/machine conversations and in this case the *heuristic* becomes a non-deterministic programme (in Manna's sense, 1970) embodied in the participant machine.

Clearly, a conversation involves individuals who participate in a *process* of understanding, retaining and learning that goes on, and it also involves a set of topics, the *conversational domain.* As a result, further compartments (subtheories) are generated.

1.2 The theory of *individuals* is concerned with characterizing potentially conscious entities, human or mechanical or both, which have certain invariant and unitary qualities (by virtue of which they count as "individuals" rather than widely disseminated organizations.)

It appears that many characterizations are possible, all of them relying upon a general notion of stability which can, with rectitude and some advantage, be conceived as a property of self replication, usually contingent upon the choice of conversational domain.

One characterization is familiar; "an individual is a human being (or his brain) regarded as a biologically self-replicating system". We call this an *M*-Individual or mechanically characterized individual. The other characterization to receive serious attention rests upon a nested series of definitions; *concept* $\triangleq$ procedure; *memory* $\triangleq$ a procedure for replicating a concept; *individual* $\triangleq$ procedure for replicating a class of memories. The resulting entity is called a *P*-Individual (psychologically characterized individual) and has many of the properties ascribed, by anthropologists to a *role* (for example, in society or industry). A *P*-Individual is also a *procedure* and, as such, is run or executed in *some* *M*-Individual, *qua* processor. However, it is quite exceptional to discover the (usually assumed) *one to one* correspondence between *M*-Individuals and *P*-Individuals; in general, the latter are more convenient units to work with though conversations involve both of them.

1.3. The (sub) theory of conversational domains in which *P*-Individuals may converse (and remain stable) is concerned with the representation of *knowable* and *learnable* relations. The representation schemes found adequate closely resemble "verb networks" but have only a peripheral (and ambiguous) connection with "noun trees", such as a species/genus classification. Moreover, an acceptable representation of *what may be known or learned* (here called an *entailment structure*) is invariably cyclic (which gives it a Gestalt property) and invariably associated with a *task structure* indicating *what may be done* to bring about the relations for which concepts have been learned. The entailment structure may be *given* by some numinous authority (for example, a curriculum specialist) or, within certain limits, it may *evolve* insofar as the participants in a conversation on this domain are able to act upon and modify the structure. In either case, generation rules must be given and justified.

1.4. The (sub) theory of *process* is applicable to all manner of decision making, interrogation etc., but is chiefly developed for a theory of learning and teaching; i.e. the conversation is a tutorial contract, the entailment/task structures represent "subject matter", one of the participants has the role *student* and one (either human or machine) the role of teacher. Within the structure afforded by the other (sub) theories it is possible to predict well-defined styles and strategies of learning, to confirm their existence, and to check their efficacity. This aspect of the theory is the most directly applicable; for example, in designing maximally informative experiments, interviews etc., or in specifying effective modes of tutorial conversations (some of them dramatically superior to others). However, the process theory is based upon the individual theory and the knowledge theory; moreover, these can be applied independently (the latter, for example, to prepare potentially informative data for advertising, course assembly, mass media presentations and management).

1.5. The (sub) theory of *vehicles* comes about as follows. The dual characterizations (M-Individual, P-Individual) which proves to be a prerequisite for the developments mentioned already, give rise to the notion that P-*Individuals* (cultural entities, minds) inhibit M-*Individuals* (processors able to interpret these procedures and, *a fortiori*, brains). It is legitimate, though at first sight bizarre, to remark that developmental psychology is a study of how a P-*Individual* comes to be correlated with a *vehicle* which is a developing M-*Individual*. Odd though it sounds, this concept turns out to be useful, though it has not yet been properly exploited.

Equally we may regard a P-*Individual* in equilibrium with (inhabiting replicating in) a different sort of M-*Individual*; for example, some collection of human beings in an institution or society (i.e. a cult); some plexus of human beings and mechanical data retrieval systems in a library or a government; in the purest and most thoroughly investigated case a vehicle such as a *motor car* or an *aeroplane* designed for moving around in space. Quite literally a driver regarded as a P-*Individual* comes to terms with the perceptual-motor/effector receptor facilities of his motor car which is an M-*Individual* very different from the body with limbs he uses to walk down a street.

Inverting the argument, the (sub) theory of process makes use of various facilities (the most advanced is the Course Assembly System and Tutorial Environment (CASTE)). These, too, are vehicles with which people *drive* through knowledge, rather than over space. It is a fascinating fact that this theoretical gambit permits the externalization of rather subtle modes of discovery; even more (given that the entailment structure is modified by the participants) to a reification of the idea that learning *is* (symbolic) evolution. As a result of this identification, it is possible to present the theory and calculus of innovation, promised in the last paragraph of the previous paper in this journal.

2. It is inevitable and salutory that a body of work with the pretensions I have outlined should be subject to highly critical appraisal.

2.1. The most frequently encountered criticism, so far, is that we deal with "disembodied minds". We might, perhaps, do so (an interesting philosophical issue resting upon how the imperative and mood of a function is related to the function graph). An essay in this direction would be no more or less defensible than the present habit, exemplified by the naive behaviourism of dealing with "disenminded" bodies (a type of applied macrophysiology that is undoubtedly useful but not, by the present canons, a part of psychology).

In fact, we do not generally try this trick. Our concern is mainly directed towards embodied minds, even if their embodiment is sometimes distributed.

But we do insist that *consciousness with* or *awareness of* reality is in the backbone of anypsychologically cogent observation. It is asserted, quite definitely, that cybernetics (known, sometimes, by the synonyms, general system theory, etc.) is now able to unify both kinds of being. Moreover, the present theory is cybernetic in a quite profound and recently mathematicized sense (not, in the trivial sense of "boxes and feedback loops").

2.2. As such, this series of papers marks a radical departure from the tacit norms of behavioural science. Being alive to the potential criticism and sharing, with the reader, a certain, not always welcome, need to rethink the fundamentals of our discipline, we try to approach the matter in a very factual way using artifacts that incorporate the theoretical principles.

The first paper, for example, describes a fairly conventional experiment of a kind however, suggested by the theory. It exhibits a method of externalizing and predicting detailed *strategies* of learning; it shows that different types of strategy exist and are clear-cut with respect to a given conversation; it describes one procedure, called "teachback" (which gives rise to explanations of explanations) that is often used in the sequel to test for the existence of memorable concepts that can be reconstructed or reproduced.

The next paper describes the operation of CASTE, which is a tangible object, made in the metal, as well as the embodiment of all the sub-theories. Only after that are more esoteric notions introduced; for example, a proper characterization of *conversations* or a proper characterization of P *Individuals*. Even here, we try to leaven the inversions of thought (akin to coming-to-terms with Spenser-Brown's (1969) calculus or akin to converting a "valve and relay man", like myself, into a "transistor man") with ample practical applications in learning, teaching, opinion shaping, market research and the control of vehicles.

GORDON PASK

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Errata

p. 314 line 7, for "Fig. 17" read "Fig. 21 and the molecular data in Fig. 17".
p. 315 line 8, for "Fig. 22" read "Fig. 18".
p. 324 line 3, for "the results in Fig. 17" read "the matching latency pattern results in Fig. 17".
p. 324 line 4, for "Section 1" read "Section 18".